

SSN 774 *Virginia* Class Submarine

Executive Summary

- Two FOT&E events occurred in FY11. The first event examined the *Virginia* class' ability to conduct under-ice Arctic operations including Anti-Submarine Warfare (ASW) and the second event examined the *Virginia* class' performance equipped with a recently modernized combat system and sonar suite.
- The Navy had planned to update the TEMP by March 2011. However, the Navy requested, and DOT&E agreed, to postpone the update to allow for additional test planning. The revised TEMP is planned to be signed in mid-FY12 and will include plans for testing the next variant of the class, called Block III.
- FOT&E continues to reveal that *Virginia* class performance is dependent on the performance of separately managed sub-systems that are integrated into *Virginia*'s Non-Propulsion Electronics Systems (NPES). Preliminary results from FOT&E show that DOT&E's original assessments from IOT&E regarding mission effectiveness remain unchanged, despite the upgrades to many NPES programs.

System

- The *Virginia* class submarine is the replacement for the aging fleet of *Los Angeles* class submarines. The *Virginia* class:
 - Is designed to be capable of targeting, controlling, and launching Mk 48 Advanced Capability (ADCAP) torpedoes, Tomahawk cruise missiles, and future mines.
 - Is designed to have sonar capability similar to the *Seawolf* submarine class with improvements to the electronic support suite and combat control systems.
 - Has a new-design propulsion plant incorporating components from previous submarine classes.
 - Uses a modular design and significant commercial off-the-shelf computer technologies and hardware intended to allow for rapid and cost-effective technology refresh cycles.
- The *Virginia* class submarines are being procured and incrementally upgraded in a series of blocks. Each block is procured with a multi-year contract; however, not each block will incorporate a major design change.
 - Block I (hulls 1-4) and Block II (hulls 5-10) ships incorporated the initial design of the *Virginia* class.
 - Block III (hulls 11-18) ships will include the following affordability enhancements:



- A Large Aperture Bow array will replace the spherical array in the front of the ship.
- Two *Virginia* payload tubes will replace the 12 vertical launch tubes. Each payload tube is capable of storing and launching six Tomahawk land attack missiles used in strike warfare.
- The design for Block IV and beyond ships has not been finalized.

Mission

The Operational Commander will employ the *Virginia* class submarine to conduct open-ocean and littoral covert operations in support of the following submarine mission areas:

- Strike Warfare (STW)
- Anti-Submarine Warfare (ASW)
- Intelligence, Surveillance, and Reconnaissance (ISR); Indications and Warnings (I&W); and Electronic Warfare (EW)
- Anti-Surface Ship Warfare (ASUW)
- Naval Special Warfare (NSW)
- Mine Warfare (MIW)
- Battle Group Operations (BGO)

Major Contractors

- General Dynamics Electric Boat – Groton, Connecticut
- Northrop Grumman Shipbuilding Newport News – Newport News, Virginia

Activity

- DOT&E approved the *Virginia* TEMP Revision F in November 2009 to include FOT&E. Two FOT&E events occurred in FY11 in accordance with DOT&E-approved test plans on two different *Virginia* class submarines.
 - The first FOT&E event occurred in March 2011 and examined the *Virginia* class's ability to conduct under-ice and Arctic operations, as well as the ability to conduct ASW in the Arctic. This was the second time a *Virginia* class submarine operated under-ice. As part of the transit to northern latitudes, testers also examined the *Virginia* class' susceptibility to fixed passive sonar arrays.
 - The second FOT&E period consisted of a series of events to examine the modernization of the *Virginia* class submarines' combat control system. These tests were combined with the operational evaluations of the latest variants of the Acoustic Rapid Commercial Off-the-Shelf Insertion (A-RCI) Sonar System, the AN/BYG-1 Combat Control System, and the Mk 48 ADCAP torpedo. Testing examined *Virginia*'s ability to conduct ASW, Mine Detection and Avoidance, Strike, Information Assurance, and Contact Management in areas of high-density surface ship traffic.
- The Navy planned to update the TEMP by March 2011 per the Milestone III Acquisition Decision Memorandum. However, DOT&E agreed to postpone the update to allow for additional test planning. The revised TEMP is planned to be signed in mid-FY12 and will include plans to test deferred capabilities and planned upgrades, particularly the Block III variant of the submarine.
- Because Navy security rules prevent the ability to collect useful operational test data from *Virginia* when conducting exercises with foreign ASW capable platforms, the Navy finished IOT&E without testing the *Virginia* class submarine against one of its primary threats, the foreign diesel electric submarine (SSK). The Navy is investigating alternative test strategies and will provide an update in the next revision of the TEMP. DOT&E has already provided a partial assessment in the Beyond Low-Rate Initial Production (BLRIP) report issued in November 2009. Additional testing, if any, will be documented in the TEMP update.
- The Block III design will require shock testing of the Common Weapons Launcher and the *Virginia* Payload Tube hatch. The hatch shock qualification test series is scheduled for spring of 2012 to support the first Block III delivery in August 2014.
- The Navy is performing a verification and validation of the Transient Shock Analysis modeling method used for the design of *Virginia* Class Block III items. The Transient Shock Analysis modeling method is scheduled to be accredited in January 2013.

Assessment

- The Navy achieved testing efficiencies by combining operational testing of several programs into coordinated test events. Since testing is interdependent, the consolidation of the *Virginia*, A-RCI, acoustic arrays, other sensors, and

AN/BYG-1 TEMPs into an Undersea Enterprise Capstone document would increase testing efficiency and enable a full end-to-end evaluation of submarine capability in the applicable mission areas.

- An FOT&E event was conducted at the end of FY10 to examine *Virginia*'s susceptibility to low-frequency active sonar and the ship's ability to conduct ASUW in a low-frequency active environment. This test event was not adequate due to last minute changes in the Fleet Exercise that prevented *Virginia* from conducting any ASUW operations. Additionally, differences in the transmit power of the low-frequency active source precluded an accurate comparison of susceptibility between the *Los Angeles* class and the *Virginia* class submarines present. Additional testing will be required to complete the FOT&E requirements in this area.
- The FOT&E event in the Arctic was adequate. DOT&E's assessment of *Virginia*'s effectiveness in the Arctic environment and *Virginia*'s susceptibility to low-frequency fixed passive sonar arrays will be contained in a classified report, expected to be issued in early FY12.
- The FOT&E event that examined the modernization of the *Virginia* class submarine's NPES were adequate with one exception. Testing to examine *Virginia*'s susceptibility to some mine types must be repeated.
- Since *Virginia*'s mission performance is significantly dependent on supporting acquisition programs that make up the *Virginia* combat and weapons systems, *Virginia* inherits the performance capabilities of these systems. The A-RCI sonar, the AN/BYG-1 Combat Control System, and the Mk 48 ADCAP torpedo are examples of systems with known performance limitations or reliability problems that affected *Virginia*'s performance during FOT&E.

Recommendations

- Status of Previous Recommendations. The Navy has made progress in addressing 17 of the 33 recommendations contained in the November 2009 classified BLRIP report. Eight of the outstanding recommendations are classified. Of the remaining eight unclassified comments, the key recommendations are:
 1. Test against an SSK threat surrogate in order to evaluate *Virginia*'s capability, detectability, and survivability against modern diesel-electric submarines.
 2. Conduct ASW-search testing to assess *Virginia*'s capability with other towed arrays (i.e., TB-16 and TB-23).
 3. Complete ASUW testing and investigate alternatives to the Atlantic Undersea Test Evaluation Center for ASW and ASUW testing.
 4. Measure the ISR-intercept metrics with a deployment-outfitted *Virginia* class submarine and with realistic threat signals.
 5. Conduct FOT&E to examine *Virginia*'s susceptibility to airborne ASW threats such as Maritime Patrol Aircraft and helicopters.

NAVY PROGRAMS

- FY11 Recommendations. The Navy should:
 1. Consolidate the *Virginia*, A-RCI, and AN/BYG-1 TEMPs into an Undersea Enterprise Capstone document.
 2. Complete the verification, validation, and accreditation of the Transient Shock Analysis method used for *Virginia* Class Block III items.
 3. Repeat the FOT&E event to determine *Virginia*'s susceptibility to low-frequency active sonar and *Virginia*'s ability to conduct ASUW in a low-frequency active environment. This testing should include a *Los Angeles* class submarine operating in the same environment to enable comparison with the *Virginia* class.

NAVY PROGRAMS